

amplifier as part of a circuit designed for a load such as a transmission line, and preferably optimized to the medium used. The output impedance of the amplifier typically matches the characteristic impedance of the transmission line. The line driver typically converts the logic levels used by the module internal digital logic circuits (e.g., CMOS, TTL, LSTTL and HCMOS) to a signal to be transmitted over the medium. At the receiving device, a line receiver is used which typically converts the received signal to the logic levels used by the module internal digital logic circuits (e.g., CMOS, TTL, LSTTL and HCMOS). A set of a line driver and a line receiver is commonly referred to as, or is part of, a transceiver (transmitter+receiver), and is used in nodes that both transmits digital data to the medium and receives digital data from the medium. In the case where the signal over the medium is modulated, a modem (a MODulator-DEModulator) device is used, which encodes digital information onto an analog carrier signal by varying their amplitude, frequency, or phase of that carrier. The demodulator extracts digital information from a similarly modified carrier. A modem transforms digital signals into a form suitable for transmission over an analog medium.

[0008] Wire. An electrical wire is a single, usually cylindrical, flexible strand or rod of metal, typically for carrying electricity and telecommunications signals. Wire is commonly formed by drawing the metal through a hole in a die or draw plate, and wire gauges come in various standard sizes, as expressed in terms of a gauge number. Wire comes in solid core, stranded, or braided forms. Although usually circular in cross-section, wire can be made in square, hexagonal, flattened rectangular, or other cross-sections, either for decorative purposes, or for technical purposes such as high-efficiency voice coils in loudspeakers. A wire pair consists of two like conductors employed to form or serve an electric circuit.

[0009] Cable. An electrical cable is an assembly of one or more insulated conductors, or optical fibers, or a combination of both, within an enveloping jacket, where the conductors or fibers may be used singly or in groups. A typical electrical cable is made of two or more wires running side by side and bonded, twisted, or braided together to form a single assembly, the ends of which can be connected to two devices, enabling the transfer of electrical signals from one device to the other.

[0010] Wireline. Wireline or wired network uses conductors, typically metallic wire conductors, as the transmission medium. The transmission mediums used in common wirelines include twisted-pair, coaxial cable, stripline, and microstrip. Microstrip is a type of electrical transmission line, which can be fabricated using printed circuit board technology, and is used to convey microwave-frequency signals. It consists of a conducting strip separated from a ground plane by a dielectric layer known as the substrate. Microwave components such as antennas, couplers, filters, power dividers etc. can be formed from microstrip, with the entire device existing as the pattern of metallization on the substrate. A stripline circuit uses a flat strip of metal, which is sandwiched between two parallel ground planes, where the insulating material of the substrate forms a dielectric. The width of the strip, the thickness of the substrate and the relative permittivity of the substrate determine the characteristic impedance of the strip, which is a transmission line. Various cables are described in "Technical Handbook & Catalog" Twelfth Edition published 2006 by Standard Wire

& Cable Co., which is incorporated in its entirety for all purposes as if fully set forth herein.

[0011] Twisted pair. A twisted wire pair is a pair of individually insulated conductors (or wires) twisted together and treated as an entity in the transmission of electrical signals or power. A twisted-pair is usually composed of two individually insulated solid or stranded conductors (or wires). Because the wires are twisted together, interfering signals tend to create opposing electromagnetic forces at frequent intervals, reducing the effect of the interference on the signal or power supply voltage being conducted. In balanced pair operation, also known as differential mode transmission, the two wires carry equal and opposite signals and the destination detects the difference between the two. Noise sources introduce signals into the wires by coupling of electric or magnetic fields and tend to couple to both wires equally. The noise thus produces a common-mode signal, which is canceled at the receiver when the difference signal is taken. Balanced twisted wire pairs are standardized under Telecommunications Industry Standard (TIA) that is part of the Electronic Industries Alliance (ETA) in ANSI/TIA/EIA-568-B.2-2001 entitled: "*Part 2: Balanced Twisted-Pair Cabling Components*" standard published May 2001, which is incorporated in its entirety for all purposes as if fully set forth herein.

[0012] Unshielded Twisted Pair (UTP). An Unshielded Twisted Pair (UTP) cable, used extensively in telephone networks and in many data communications applications, is not surrounded by any shielding. Common indoor UTP cables are used for Ethernet, and are typically made with copper wires measured at 22 or 24 American Wire Gauge (AWG), with the colored insulation typically made from an insulator such as polyethylene or FEP and the total package covered in a polyethylene jacket. For urban outdoor telephone cables containing hundreds or thousands of pairs, the cable is divided into smaller but identical bundles. Each bundle consists of twisted pairs that have different twist rates. The bundles are in turn twisted together to make up the cable. Pairs having the same twist rate within the cable can still experience some degree of crosstalk.

[0013] Shielded Twisted Pair (STP). Twisted-pair cables are often shielded in an attempt to prevent electromagnetic interference. Shielding provides an electrically conductive barrier to attenuate electromagnetic waves external to the shield, and provides a conduction path by which induced currents can be circulated and returned to the source, via ground reference connection. This shielding can be applied to individual pairs or quads, or to the collection of pairs. Individual pairs are foiled, while overall cable may use braided screen, foil, or braiding with foil. When shielding is applied to the collection of pairs, this is usually referred to as screening, but different vendors and authors use "screening", "shielding", and "STP" inconsistently to denote various shielded cable types. International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) ISO/IEC 11801:2002 Standard internationally standardize the various designations for shielded cables by using combinations of three letters—U for unshielded, S for braided shielding (in outer layer only), and F for foiled shielding—to explicitly indicate the type of screen for overall cable protection and for individual pairs or quads, using a two-part abbreviation in the form of x/xTP. Because the shielding is made of metal, it may also serve as a ground. Usually a shielded twisted pair cable has a special